

Original Research Article

Chemical hazard and healthcare workers; findings from a tertiary health institution in south-western Nigeria

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ABSTRACT

Background: Improvement in diagnostic and therapeutic services has further increased the hazards in healthcare facilities, particularly the chemical hazard. Therefore, the need for more focus on chemical hazard exposure among healthcare workers. This study aimed to assess the perception of healthcare workers about chemical hazards associated with their job and the pattern of adopted preventive measures.

Methods: A descriptive cross-sectional study was employed. One hundred and seven healthcare workers were enrolled in the study. The sample size was proportionally allocated to various departments that provide care directly to patients. Data on workers' perceptions about chemical hazard exposure and utilization of preventive measures were obtained using self-administered questionnaire.

Results: Majority of the respondents had high level of awareness (86.0%) and knowledge (81.3%) of chemical hazards. About one-fifth, 24 (22.4%), had experienced inadvertent exposure to chemical hazards. Gender, knowledge, and perception of chemical hazards had statistically significant associations with the use of personal protective equipment (PPE). Females are more likely to use PPE than male (odds ratio=5.1, p=0.008) and respondents with good perception of chemical hazard exposure are more likely to use PPE relative to respondents with poor perception (odds ratio=11.8, p=0.018). Standard operating procedures were available to less than half of the respondents, 52 (48.6%).

Conclusions: There is a need for continuous strengthening of available safety measures to further reduce incidences of inadvertent chemical hazard exposure. The hospital management should ensure availability of standard operating procedures at all service locations.

Keywords: Chemical hazards, Healthcare workers, Tertiary health institution

INTRODUCTION

Health care workers are prone to various forms of hazard, including chemical hazards in the course of discharging their duty. The use of chemicals has increased in healthcare settings particularly the tertiary health care facilities due to advances in diagnostic, curative, and preventive services.^{1,2} The effect of exposed chemical hazards may vary from mild to toxic ones depending on the job specifications and nature of service rendered in various

units of the hospitals. It could also have acute or chronic effects from long-term exposure.³

Healthcare workers constitute a significant proportion of the working population. This shows that a significant proportion of the population is exposed to numerous potential hazards which include physical, biological, psychosocial hazards, and chemical hazards.^{2,4} Like other workplaces, they are equally at risk of fire outbreaks and explosions from different types of gas used within the

hospital.^{2,4} Despite the high rate of chemical use among healthcare workers, chemical hazard has generated the least attention in terms of research compared with biological and physical hazards.

Common examples of chemical hazards with which healthcare workers routinely had contact include medications like anaesthetic agents, antineoplastic agents, aerosolised medication and radioactive substances. Other common toxic chemicals used by various cadres of healthcare workers include mercury, methyl methacrylate, xylene, and other organic solvents like formaldehyde; building maintenance materials, such as asbestos; cleaning and sterilizing compounds, such as ethylene oxide, sodium hypochlorite (bleach), glutaraldehyde, phenol; and gloves used to prevent blood exposure such as latex.^{2,4}

Prevention against hazard exposure at the healthcare facility level is mainly through the use of personal protective equipment and administrative controls. The common administrative control measures include limitation of duration of exposure through the practice of shift system, provision of standard operating procedure (SOPs), provision of opportunities for leaves, and on-the-job training. Since most studies on hazards among health care workers focused mainly on biological hazards, this study aimed to assess the chemical hazard exposure and the perception of healthcare workers. The study also assessed hazard control with a focus on administrative control and use of personal protective equipment (PPE). A tertiary health facility was chosen for this study because it offers a wide range of services that may not be available at lower levels of health care; thus, providing a comprehensive view of chemical hazard exposure among healthcare workers.

METHODS

This study was conducted among health care workers at Obafemi Awolowo University Teaching Hospital, a tertiary health care facility in Ile-Ife, South-West Nigeria. Obafemi Awolowo University Teaching Hospital offers diagnostic, curative, preventive, and rehabilitative services for various illnesses. The institution's staff can be broadly classified into those providing direct health services and indirect services (administrative staff). Preliminary investigations revealed that there are chemicals that are common in all units of the hospital while some chemicals are peculiar to some departments, depending on the nature of services being rendered at the unit.

Study design and study population

The study was conducted using a descriptive cross-sectional design. The study population included only health care workers in the units that provide health care services directly to patients. The temporary staff of selected units, like healthcare workers under training, were excluded from the study.

Sample size and sampling technique

A sample size of 107 was calculated using the sample size formula for a single proportion. The sample size was proportionally allocated to various units including the medical and nursing services, laboratory, morgue, theatre and environmental health unit. The cleaners were also involved in the study. The respondents in these subgroups were enrolled until the allocated numbers of respondents were achieved. The enrolment was spread across different shifts to ensure adequate representation of staff in various units that operate based on shift systems.

Data collection

Data were collected in January 2020. Data were collected using a self-administered questionnaire while interviewer-administered method was used for data collection among cleaners and other workers with lower levels of education. The questionnaire consisted of six sections: section A contained questions on the socio-demographic data while section B assessed the knowledge of workers about chemical hazards and PPE. Section C contained questions on the perception of healthcare workers about chemical hazards and protective measures based on the constructs of the health belief model.⁹ This section was rated on a 5-point Likert scale where 1 represented "strongly disagree" and 5 represented "strongly agree". Section D assessed the use of PPE while section E assessed common perceived symptoms while at work. Section F assessed the administrative control of hazard exposure.

Data analysis

Data were analysed using IBM statistical package for the social sciences (SPSS) version 25 for Windows.¹⁰ Categorical variables like socio-demographic variables, level of knowledge of PPE, and exposure to chemical hazards were summarized using frequency and proportion. Associations between sociodemographic variables, knowledge, and perception of chemical hazards with the use of PPE were assessed using Chi-square. Those who use appropriate PPE every time while on duty were classified as using PPE regularly. Determinants of PPE use were further assessed using binary logistic regression. A p value of less than 0.05 was considered to be statistically significant.

Ethical consideration

Ethical approval was obtained from the research and ethics committee of the Institute of Public Health (IPH), Obafemi Awolowo University, Ile-Ife, Nigeria. Verbal consent was sought from each respondent after an adequate explanation of the objectives of the study.

Confidentiality and data security were assured. Participation was made voluntary as each participant was at liberty to opt-out at any point in the study.

RESULTS

Most of the respondents were Christian (80.4%) while Islam accounted for 18.7% of the respondents. Both genders were almost equally represented, female (50.5%) and male (49.5%). Majority of the respondents have tertiary education 98.1% and were married 81.3%. More than half of the respondents (55.1%) were on shift system, while 29% of the respondents work between 8 am to 4 pm. Distributions of respondents across the units of the hospital and details of socio-demographic characteristics are as shown in Table 1.

Table 1: Socio-demographic characteristics.

Variables	Frequency (%)
Sex	
Male	53 (49.5)
Female	54 (50.5)
Religion	
Christianity	86 (80.4)
Islam	20 (18.7)
Others	1 (0.9)
Level of education	
Primary	1 (0.9)
Secondary	1 (0.9)
Tertiary	105 (98.1)
Marital status	
Single never married	19 (17.8)
Married	87 (81.3)
Separated/divorced	1 (0.9)
Department	
Environmental health unit	16 (15.0)
Lab	26 (24.3)
Radiology	5 (4.7)
Theatre	3 (2.8)
Medical and nursing services	32 (29.9)
Morgue	2 (1.9)
Health attendant/cleaner	18 (16.8)
Others	5 (4.7)
Nature of duty	
Shift	59 (55.1)
Call duty	16 (15.0)
8 am-4 pm	31 (29.0)
Night only	1 (0.9)

Almost all of the respondents (86.0%) were aware of the health risk of chemical hazards. Most of the respondents (81.3%) had overall good knowledge about chemical hazard exposure, with about three-quarters (75.7%) having good knowledge of symptoms and 86% having good knowledge of PPE. Less than one-fourth (22.4%) experienced adverse exposure to chemicals. Details are shown in Table 2.

Nose masks and hand gloves were the most regularly used PPE, 52.3%, and 75.7% respectively. PPEs that most

HCWs never used were respirators with filter (57.9%), respirator with airline (63.6%), face shield (50.5%), and hearing protector (65.4%). Details are shown in Table 3.

Majority of the respondents used PPE regularly, 87 (81.3%) while others were inconsistent with PPE use. Symptoms mostly reported by the respondents were recurrent catarrh and cough; 44.0% and 32.7% respectively. Other reported symptoms were headache (26.2%), difficulty with breathing (23.4%), damage to the eyes (18.7%), and skin rash (25.2%). The least reported symptom was damage to any internal organs (7.5%).

Table 2: Knowledge of chemical hazard exposure.

Variables	Frequency (%)
Awareness of health risk of chemical hazards	
No	7 (6.5)
Yes	93 (86.0)
Not sure	8 (7.5)
Knowledge of symptoms	
Poor	26 (24.3)
Good	81 (75.7)
Knowledge of PPE	
Poor	15 (14.0)
Good	92 (86.0)
Overall knowledge	
Poor	20 (18.7)
Good	87 (81.3)
Experience of adverse exposure to chemicals	
No	74 (69.2)
Yes	24 (22.4)
Unknown	9 (8.4)

Most of the respondents (68.2%) were aware that the health facility had existing SOP specific to their work areas, but more than half of them (51.4%) said the SOP documents were not available to them. Almost all the respondents (92.5%) were willing to participate in on-the-job training. About three-fifths of the respondents (60.7%) were aware of the existence of a reporting structure for hazard exposure. Most of the respondents (63.6%) were not aware of existing points for reporting hazard exposure. Details are shown in Table 4.

Table 5 shows the association between respondents' characteristics and regularity of PPE use. The proportion of females that use PPE regularly, 90.7%, was significantly higher than that of males, 71.7% ($p=0.012$). Regular use of PPE was more common among people with good knowledge of chemical hazards, 85.9%, than respondents with poor knowledge, 53.3%, ($p=0.003$). There was also a significant association between the perception of chemical hazard exposure and PPE use ($p=0.044$). Using binary logistic regression analysis, perception of chemical hazard exposure, and sex of healthcare workers were significant determinants of regular PPE usage. The respondents with good perceptions of exposure to chemical hazard are 11.8

times more likely to use PPE regularly compared to those with poor perception (odds ratio=11.8, p=0.018). Female respondents are 5.1 time more likely to use PPE regularly

compared with male respondents (odds ratio=5.1, p=0.008). Details are shown in Table 6.

Table 3: Practice of PPE use on the job.

Variables	Frequency (%)
Safety goggle	
Never	59 (43.9)
Occasionally	16 (47.7)
Regularly	31 (8.4)
Respirator with filter	
Never	62 (57.9)
Occasionally	31 (29.0)
Regularly	14 (13.1)
Respirator with airline	
Never	68 (63.6)
Occasionally	29 (27.1)
Regularly	10 (9.3)
Face shield	
Never	54 (50.5)
Occasionally regularly	32 (29.9)
Nose mask	21 (19.6)
Never	4 (3.7)
Occasionally	47 (43.9)
Regularly	56 (52.3)
Hand gloves	
Never	3 (2.8)
Occasionally	23 (21.5)
Regularly	81 (75.7)
Safety boot	
Never	24 (22.4)
Occasionally	52 (48.6)
Regularly	31 (29.0)
Water-proof overall	
Never	33 (30.8)
Occasionally	50 (46.7)
Regularly	24 (22.4)
Hearing protector	
Never	70 (65.4)
Occasionally	28 (26.2)
Regularly	9 (8.4)

Table 4: Existence and awareness of precautionary measures in the health facility.

Variables	Frequency (%)
Existence of SOP specific to respondents' work	
No	16 (15.0)
Yes	73 (68.2)
Not sure	18 (16.8)
Availability of SOP documents to the respondents	
No	55 (51.4)
Yes	52 (48.6)
Willingness to participate in on-the-job training	
No	8 (7.4)
Yes	99 (92.5)
Awareness of the existence of reporting structure for hazard exposure	

Continued.

Variables	Frequency (%)
No	21 (19.6)
Yes	65 (60.7)
Not sure	21 (19.6)
Existing point for reporting hazard exposure	
Accident and emergency	12 (11.2)
Management (HOD, director, superior member of the team)	7 (6.5)
Hazard and safety unit	3 (2.8)
Staff clinic	17 (15.9)
Nil	68 (63.6)

Table 5: Association between respondents' characteristics and regularity of PPE use.

Variables	Regularity of PPE use		Statistics
	Poor	Good	
Age group			
Less than 30	3 (11.1)	24 (88.9)	X ² =1.393
31-40	13 (21.7)	47 (78.3)	df=1
41 and above	4 (20.0)	16 (80.0)	p=0.498
Sex			
Male	15 (28.3)	38 (71.7)	X ² =6.382
Female	5 (9.3)	49 (90.7)	df=1
Religion			
Christianity	14 (16.3)	72 (83.7)	LR=2.242
Islam	6 (30.0)	14 (70.0)	df=2
Traditional	0 (0.0)	1 (100.0)	p=0.326
Nature of duty			
Shift	7 (11.9)	52 (88.1)	LR=4.765 df=3 p=0.190
Call duty	4 (25.0)	12 (75.0)	
8 am-4 pm	9 (29.0)	22 (71.0)	
Night only	0 (0.0)	1 (100.0)	
Knowledge of chemical hazard			
Poor	7 (46.7)	8 (53.3)	X ² =8.984
Good	13 (14.1)	79 (85.9)	df=1
Perception of chemical hazard exposure			
Poor	3 (60.0)	2 (40.0)	Fisher's exact=5.889
Good	17 (16.7)	85 (83.3)	df=1
p=0.044			

** Regularity is the proportion of respondents that use at least on PPE regularly (i.e. when on duty)

Table 6: Binary logistic regression of association between respondents' characteristics and regularity of PPE use.

Variables	Odds ratio	P value	95% CI
Knowledge of PPE			
Poor	Ref	0.101	0.820 – 9.260
Good	2.8		
Perception of chemical hazard exposure			
Poor	Ref	0.018	1.524 – 91.798
Good	11.8		
Sex			
Male	Ref	0.008	1.521 – 17.269
Female	5.1		

DISCUSSION

Majority of the respondents had tertiary level of education. This could be due to the minimum level of education

required for employment in most units of the hospitals. Similar patterns were observed in related studies.^{5,11,12} More than half of the respondents practice shift systems while 3 out of 10 worked for a fixed period of eight hours

per day. There is thus, a limited period of exposure to chemical hazards.

More than 8 out of 10 respondents were aware and had good knowledge of health risks associated with chemical hazards exposure. This could be due to the higher level of knowledge of respondents and the orientation programs for workers. The finding was similar to what was observed in similar studies conducted among healthcare workers in Lagos.¹² The studies were however not specific for chemical hazards, but awareness of occupational hazards generally. Poor knowledge of chemical hazards was however observed among health care workers in similar studies conducted in Southeast Nigeria and Turkey.^{13,14} This could be due to variation in the level of education as the highest level of education among majority of respondents in the study conducted in the south-east of Nigeria was secondary. High level of knowledge of chemical hazards was observed among darkroom technicians and assistants practicing in the south-east of Nigeria.¹⁴ The study was however limited to chemicals used in X-ray processing.

In this study, administrative controls and use of PPE were the commonly adopted preventive measures against chemical hazards from the hierarchy of hazard control. Eight out of ten respondents use PPE regularly while others had poor use of PPE. The proportion that used PPE regularly was higher than findings from similar studies among other healthcare workers in Lagos and Niger states where only about 4 out of 10 and 6 out of 10 participants adopted safety practices at work respectively.^{12,15} Also, the use of PPE among healthcare workers at a tertiary healthcare institution was observed to be very low compared with the findings from this study.¹⁶ This could be due to variation in the implementation of hazard control policies of the institution and availability of PPE because respondents in both studies demonstrated high level of awareness of PPE.

Gender was a significant determinant of consistent use of PPE as females had higher odds of being consistent with PPE use compared with males. The finding was similar to the result from the study among healthcare workers in Lagos and Rivers states where gender was a significant factor affecting the adoption of safety practices.^{12,17} This was at variance with the findings from a similar study conducted at North-Western Nigeria where there was no significant association between gender and practice of safety measures.¹⁸ The study, however, focused more on biological hazards. Perception of effects of chemical hazards was also a significant determinant of PPE use among the respondents. Those with good knowledge of chemical hazards were also more likely to use PPE, though this was not significant. This was similar to findings from various studies that assessed the association between perception and knowledge of occupational hazards, and use of PPE among healthcare workers.¹⁹⁻²¹ A study, however, showed no significant association between level of knowledge of hazards and intention to use PPE, as the

intention to use PPE was low among the health care workers despite the high level of knowledge of hazards associated with management of patients with tuberculosis.²²

About one-fifth of the respondents had experienced inadvertent exposure to chemical hazards among the respondents. This finding was similar to the result of a similar study among healthcare workers in Ondo state. The prevalence of chemical hazard exposure in this study was lower than the prevalence of inadvertent chemical hazard exposure among healthcare workers in Ondo state where the prevalence was about 3 out of 10.²³

The study was however conducted at a secondary level of healthcare, thus, they may not have access to the same protective measures relative to tertiary health facilities. The low prevalence of inadvertent chemical hazard exposure reported in this study could be due to high level of knowledge of chemical hazards and PPE use among respondents. It could also be due to administrative control measures like accessibility to SOPs, limited period of work for the majority respondents, and the existence of monitoring and reporting structure for hazards exposures.

The common perceived symptoms were constitutional symptoms like recurrent catarrh, cough, and headache, which may not be occupationally related. Few people, however, reported skin rash, damage to the eye, or other organs. These could be due to inappropriate and inconsistent use of PPE among the affected respondents.

There are few limitations to this study. Involvement of other levels of care and private hospitals would have been more appropriate, but this would have been logistically difficult. A tertiary health facility was selected which provides a fair estimate of experience in healthcare settings because it provides more comprehensive service, some of which may not be available at lower healthcare facilities. The assessment of inadvertent exposure is also prone to recall bias. The period of assessment was however limited to the last three months before the study.

CONCLUSION

Majority of the respondents had good levels of awareness and knowledge of chemical hazards in the healthcare facilities. Majority of the respondents equally used PPE consistently and appropriately. However, SOPs were available to only about half of the respondents. Although majority of the respondents used PPE regularly, about one-fifth still experienced inadvertent exposure to chemical hazards. There is, therefore, a need to strengthen compliance with existing safety measures like correct and consistent use of PPE. There is also a need for management to make relevant SOPs available for all workers at the service points to enable the delivery of services according to the guideline. This will consequently reduce hazard exposure.

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